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ABSTRACT

This study tested the hypothesis that a 6-month, half-day program of enrichment in language and Piagetian sensorimotor skills tailored to the cognitive-developmental level of infants would accelerate the development of participating infants. The experimental population consisted of 16 12-month-old infants attending enrichment sessions at Syracuse University's Children's Center. The control group consisted of 16 12-month-old infants who received no intervention. All the infants were black and from low income homes. The tests used in assessment were: a standardized infant global IQ test, the Cattell Infant Intelligence Scale, the Early Language Assessment Scale, and the Piagetian Infancy Scales. The results demonstrated that females benefited more than males from the enrichment program, possibly due to differential home treatment. The advances made by the experimental infants both on the Object Permanence Scale and the Means-Ends Scale compared to their controls offers encouragement to explicitly planned enrichment efforts, based on a Piagetian cognitive-developmental model and designed to offset cognitive deficits that sometimes result when an infant is not provided the variety, sequencing and challenge appropriate to his level of experiences. (AJ)

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A Comparative Analysis of the Piagetian Development of Twelve Month Old Disadvantaged Infants in an Enrichment Center with others not in such a Center[1]

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The past few years have witnessed something of an adolescent growth spurt in research with preschool children and programs. Many of these efforts have been spurred first by discoveries of the socially detrimental effects of inadequate or interrupted mothering on young children's emotional and social behaviors (Spitz, 1945; Bowlby, 1952). Casler (1961) has explored the effects of inadequate sensory experience. Inadequate cognitive or linguistic stimulation associated with lower socio-economic status has been demonstrated by Hess, Shipman, Brophy, and Bear (1969), and Coleman et al. (1966). Most of the studies which yielded evidence of deficit functioning in lower socio-economic group children have done so only when the children reached the second or third year of life (Bayley, 1965; Hindley, 1962; Golden et al., 1969). Thus, preventative programming in early childhood tended to concentrate on toddlers and older preschoolers. Establishment of the format and content of what Caldwell (1967) characterizes as the "optimal learning environment" for the young child in these programs has been based both pragmatically on observed deficits, as in the Bereiter and Engelmann (1966) program of pattern drill in language, arithmetic, and reasoning skills, and also based on a wide variety of theoretical developmental principles including those of Jean Piaget.

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Caldwell (1970) has noted that exploration of the effective parameters of enrichment programs, such as teacher-child ratio, number of years in the program, degree of parent involvement, or particular program process or content variables has just recently begun. Preliminary data from such research indicates that the gains which occur on measures of intellective functioning are not so much a function of the type of intervention program, as of other factors associated with teacher involvement. This was true for the concept-training versus discovery methods used in Palmer's Harlem Discovery Project (1970), as well as for the Piagetian and verbal bombardment versus pattern drill versus traditional nursery-school models investigated by Weikart (1969).

Interest in preschool programming has turned increasingly toward the infancy period. One reason for this is the failure of wide-scale preschool intervention programs to demonstrate sizeable or lasting IQ gains (Gray and Klaus, 1970; Weikart, 1967; Westinghouse Learning Corporation, 1969; Caldwell and Smith, 1968). Interest in beginning enrichment programs in infancy has occurred despite great lacunae in our knowledge about the effectiveness of input at different ages at which enrichment is begun. Indeed, Elkind (1970) has facetiously suggested that since there is a decline in the rate of mental growth as the amount of formal schooling increases, and since almost three-fourths of mental growth takes place before formal schooling begins, perhaps "formal schooling ought to be delayed rather than introduced early" in order to maximize growth! The Freudian viewpoint would certainly opt for the designation of infancy as the optimal period for developing healthy socio-emotional behaviors. Bloom (1964) synthesized major longitudinal studies of human physical, personality, and intellective characteristics. His conclusion that a human characteristic is most vulnerable to change at periods of most rapid growth of the characteristic supports the view that cognitive enrichment

should therefore be more effective in the earlier years. Deutsch (1964), examining the role of socio-economic status in language development and cognition, proposed a cumulative deficit hypothesis with increasing grade level of low income youngsters. This hypothesis would seem to imply that early compensatory programming may wipe out deprivational influences in earlier developmental stages when such influences have lesser effects. Economic factors, such as the great increase in numbers of working mothers of young children, have given day care for infants a political and social impetus as well.

Despite the factors generating a preference for infancy as the important age to begin cognitive enrichment, few tried and tested curricula are available to infancy program directors. Some guidelines for work with infants come to us from child care specialists, pediatricians, or child analysts. Dr. Spock (1958) was an early champion of more relaxed and permissive caretaking procedures. Erikson (1963) stressed the importance of a relation of basic trust between caretaker and infant. Lézine (1964) carefully spelled out, in terms of infant developmental scale norms, the fine motor and language stimulation and types of toys appropriate to infants of varying months of age. Held and Hein's (1963) experiments with kittens suggested that self-induced motoric experience was crucial in the infant animals for adequate visual-motor development. Other animal studies (Denenberg and Karas, 1959; Levine, 1957) reported positive physical and adaptive effects in animals who had been given small amounts of extra handling as infants. Brody (1951) noticed consistent increased visual attentiveness in human babies who were handled more frequently. White and his colleagues (1967) provided extra handling, increased motility in prone posture, and visually enriched surroundings to a group of hospital-reared infants and found that the onset of hand regard, visually directed reaching, and the growth of visual attentiveness were increased compared to control babies. Infant conditioning and learning

studies, as Horowitz (1968) has pointed out in her recent review, have identified a host of reinforcers, from milk to blinking lights to social cooing, which are effective in infant learning and behavior modification. Berlyne (1960) has emphasized the importance of stimulus change or novelty as an effective contingent reinforcer. Hunt (1965) has stressed the importance of intrinsic motivation in infant learning.

The importance of a responsive caretaker and of programming for stimulation was stressed by Escalona (1967) at a conference on rearing infants in institutions. She suggested that "the learning activities of handling things and dealing with them and moving around in space should be embedded in a context that not only includes a personal interchange but also an adaptation to the child's needs and desires of the moment." Bell (1970), after studying the relation of the development of object permanence in infants toward the end of the first year of life, found that mothers who take babies on frequent outings and avoid even brief daily separations have babies who are "significantly more advanced in the ability to represent persons and have less difficulty or take less time to acquire the ability to represent objects symbolically." Thus Bell provides experimental evidence that infant attachment to a caretaker who facilitates this attachment aids in the formation of the cognitive concept of object permanence.

This thesis, stressing the effect of the affective relationship of infant and caretaker on the subsequent learning career of the infant, had long been asserted by dynamic psychologists. Bruner (1966), too, as a leading cognitive theorist, has characterized intellectual development as depending upon "a systematic and contingent interaction between a tutor and a learner," and, further, that "the relations between one who instructs and one who is instructed is never indifferent in its effect upon learning." Schaefer (1970), in reporting on a home

tutoring intervention program with black ghetto infants from 14 to 36 months, stressed the importance of the relation between the college student tutors and the infants for whom they played, sang, talked, read, and created stimulating games and puzzles. Significant IQ differences in favor of experimental infants were measured at the end of the tutoring period. In another home-tutoring program, Gordon and Lally (1967) describe Piagetian tasks which their paraprofessional home visitors taught to disadvantaged mothers in the Florida Early Child Stimulation through Parent Education Project. Griffiths developmental scores (Gordon et al., 1969) indicated significant gains for the trained infants by their twelfth month of life.

Preliminary results after one year from the Ypsilanti Carnegie Infant Education Project (Weikart 1969), where maternal involvement in stimulating infant growth is a key element of concern, indicate "no statistical evidence that immediate short-term results, as measured by the Bayley Scales, favor either the paraprofessional or teacher-operated intervention programs over regular home care." Supplementary enrichment experiences provided for an hour daily for three weeks to a group of 7- to 12-month-old babies in an orphanage are described by Sayegh and Dennis (1965). These experiences were designed to help babies learn an upright sitting position and to encourage them to manipulate a variety of attractive plastic toys. Developmental IQ scores at the end of the enrichment period favored the experimental infants compared to their controls.

Jean Piaget (1952), aside from providing an abundance of delightful and penetrating observations and experiments with his own three babies to illuminate the course of infant learning, has provided us with a salient theoretical conceptualization of the learning process during the sensorimotor period from birth to two years. He has

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stressed that intelligence develops through an interactive process involving the organism and the environment in a reorganization of cognitive structures. Cognition or intelligence for Piaget (1967) refers basically to adaptive motoric acts upon the environment or to the internalization of such actions. As Kohlberg (1968) has summarized this interaction position, "mature or adequate cognition is defined by an equilibrium or reciprocity between action and object. Cognition is defined as function (modes of action) rather than as content . . . cognitive structures are rules for processing information or for connecting experienced events." The Piagetian viewpoint in addition assumes an active, stage-differentiated process whereby mental structure results from interactions between the young child and the outside world. A corollary of this interactional conception is that experiences--on a general and generous level--should be very important to enable the child to go through the process Piaget (1956) describes as a "continuous formation of structure by successive equilibrations." With respect to variation in environmental stimulation of the infant, Inhelder (1953) has enunciated the Piagetian position that "the order of succession of stages is constant, but the age at which the structures appear is relative to the environment, which can either provoke or impede their appearance." Instructional methods in an enrichment experience must take into account the cognitive discrepancy or conflict inherent in an environmental experience for a particular infant with a particular cognitive structure. Piaget hypothesizes that for effective transformation of cognitive structure one must find the appropriate degree of discrepancy between the child's schemata or his action system and the present task, object, or event confronting him. Hunt (1961) has most vividly dubbed this search the "problem of the match."

Piaget's conception of sensori-motor functioning and of the interactive process in the formation of increasingly more mature and complex cognitive structure provides the theoretical rationale for an essentially cognitive-developmental approach to

infant learning. This, then, was the model favored in setting up the infant program at the Syracuse University Children's Center. As Hodges (1969) has so succinctly expressed it, this approach "connotes an effort to 1) change the cognitive structures or processes available to the child, 2) to speed up the acquisition of these structures, and 3) to help generalize the applicability of a cognitive schema or structure to new sets of stimuli." He further suggests that this cognitive-developmental approach has a "hypothetical potential for greater generality and transfer."

Teacher Training

Intensive teacher training for the infant program was undertaken based on this model. Piaget's theory of the six stages of sensori-motor development and his concepts of primary, secondary, and tertiary circular reactions were discussed. Into these training sessions were brought volunteer demonstration babies with their mothers. Task and item presentations were then carried out by the infant teachers with the mother's help when necessary. Teachers were encouraged to use their ingenuity in finding and creating responsive toys. Toys, tasks and situations with tactual-kinesthetic, as well as auditory or visual appeal were devised to foster prehension skills, understanding of means-ends and causal relationships, object permanence, spatial relations, and the application of new schemas to objects. Familiar and unfamiliar gestural and verbal behaviors were modeled. Techniques of orienting infant attention or of making a task more attractive were devised. The teachers were encouraged to stimulate each infant to respond even minimally to the goals of a given task and to devise ways of modifying a task presentation with sensitivity to the baby's performance level and the "problem of the match." Attention to task sequencing was emphasized.

The various Piagetian object permanence tasks with screens or the space scale detour problems, for example, were not conceived strictly as a prime teaching content

of the stimulation program nor as a set of information processing skills to be taught by rote to infants. The specific Piagetian tasks were to be used rather as tools to identify areas where intensive programming across a variety of materials, situations, and developmental levels could be designed individually in conjunction with loving social-emotional interactions and enjoyable physical experiences. Thus, training sessions also included the creation of physical and rhythmic exercises appropriate for infants at different developmental levels.

Language skills are strongly emphasized in the infant program. Teachers are encouraged to enjoy books with the infants, and to sing to them. Objects, feelings, and actions are labeled not only during more structured learning times, but as an integral part of diapering, feeding, bathing, and other caretaking routines. The Early Language Assessment Scale (ELAS) has been developed and routinely used as an achievement test for infant language at the Children's Center. It records infant responsivity in terms of body or facial gestures and vocalizations, whether expressive or communicative, to visual, vocal and tactual stimuli. With the assistance of the Child Development Trainers[2] this ELAS Scale was simplified into "Basic English" and the teachers were then taught to administer the ELAS Scale to their infants. This was done to provide additional incentive for a teacher to promote her infant's vocalizations and language decoding and encoding skills.

In accordance with the emotional needs of an infant for attachment to a special person, each teacher is assigned to four babies in the infant program for whose care, loving, and lessons she is responsible. Mirrors were installed at ground level so that infants can enjoy the sight of themselves and also learn, for example, to imitate facial familiar gestures which are ordinarily invisible. Rugs on the floor facilitate frequent prone placement of infants. They also create more intimate

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[2] These are paraprofessional women, indigenous to the neighborhood in which they work. They conduct a parent education program during weekly home visits with Center families.

toy and task areas. Large wall charts in the infant rooms outline tasks, including Piagetian items, in ten curriculum areas. A teacher initials those tasks which she has worked at with a particular infant during the week. Thus she can monitor her own input in various cognitive and skill areas. A more detailed description of the training sessions for infant teachers may be found in Lally et al. (1970). This program was carried out with differing degrees of effectiveness or completeness by the infant teachers with the experimental infants who entered the Center at six months. Supplementary refresher demonstration and explanatory conferences were held for one hour every week.

Assessments[3]

At twelve months the infants were tested with a standardized infant global IQ test, the Cattell Infant Intelligence Scale, and with a language measure, the Early Language Assessment Scale (ELAS), and with the Piagetian Infancy Scales, designed to assess specifically Piagetian developmental achievement.

The Piagetian Infancy Scales were constructed from items developed by Uzgiris and Hunt (1966) in their Ordinal Scales of Infant Development,[4] from items in the Albert Einstein Scales of Sensori-Motor Development (Corman and Escalona, 1969), from the Piagetian Series on Object Permanence developed by Gouin-Decarie (1965), and from procedures developed for the Children's Center Early Language Assessment Scale (Honig and Caldwell, 1966). Procedures for administering each item were standardized, and pilot testing was done to ensure that particular infant responses

[3] In connection with efforts at assessment of the effects of preschool intervention programs it is interesting to note that Levitt (1968) has suggested that appropriate goals in children's education programs should include the development of both relevant assessment methods and of educational methodology to assess major process variables in children's cognition. She comments that some workers suggest this assessment is perhaps "best undertaken on a qualitative basis alone."

[4] The subscales of this instrument measure cognitive growth in areas including object permanence, use of objects as means, and development of an understanding of causality. The subscales have been shown to be ordinal in nature.

could be scored according to response levels specified for a given item. Items from the above scales were combined, modified and augmented to make the scales more sensitive to the range of actually emitted infant responses and to present a more complete developmental continuum with "finer gradation of steps for some of the scales" as Uzgiris and Hunt (1967) had earlier suggested. The resultant seven scales are:

I. Object Permanence
II. Means-Ends Scale: Development of means for achieving desired environmental events.
III. Development of Schemas in Relation to Objects.
IV. Development of Causality.
V. Developmental achievement of the construction of the object in space.
VI. Development of vocal and gestural imitation.
VII. Prehension.

Two responses out of five presentations or trials are required to receive a score at a particular performance level for most of the items. A scoring system has been devised such that the least amount of credit, one item point, is assigned to the response to each item that satisfies most minimally the task requirements. Infant responses below this performance level receive no credit, and response scores above this level each receive an additional item point. This enables the infant to receive additional credit for developmentally more mature responses to the same presentation, thus increasing the sensitivity of the instruments.[5] Since all the infants tested at twelve months passed all of the prehension scale items, only data from the first six scales will be presented.

Subjects

The subjects for this presentation are 32 black twelve-month-old infants,

[5] It is of interest to note Wachs' (1970) comment concerning the particular advantage of Piagetian assessments: "The primary advantage seems to be that these scales yield a pattern of individual abilities for each child rather than a heterogeneous single score. As a result, attempts at remediation can be tailored for each individual child's strengths and weaknesses." Wachs used the Uzgiris-Hunt Ordinal Scales in assessing the performance of retarded children.

either first or second born children of normal birth. The 16 experimental infants, 8 male and 8 female, attended either the morning or afternoon enrichment program at the Syracuse University Children's Center for six months. Attendance fluctuated widely for these infants, and ranged from 42 to 124 days with a mean of 84 days for the experimental group. The control group consists of 8 male and 8 female infants who have received no intervention. The mean age in weeks at testing for the experimental infants is 52.9, and for the control infants 53.3. The slight age difference in favor of the control babies is not statistically significant. Mothers of both control and experimental infants have a mean of approximately 10 grades of education. The families of both groups earn $5000.or less per year. The mothers have no work history or a semi-skilled work history. Fathers have a high school education or less.

The experimental infant's own teacher, and the control infant's mother or grandmother, accompanied him to each testing session, held him when necessary, and comforted him if necessary. Every effort was made to test babies when they were fed, comfortable, and contented. Response to a presentation was not recorded if an infant was inattentive or distracted. The approximate time required to administer these scales was 1½ to 2 hours. Most of the infants required two or three separate sessions for completion of the Piagetian Infancy Scales. Testing was usually completed within two to three separate sessions, and in no case did more than 14 days elapse between test sessions. All scales were administered in entirety, except for Scale I, Object Permanence, where testing was discontinued after three consecutive item presentations received a zero response score. Because of the ordinal nature of the scales, an infant was considered to have failed all items above that level.

Results

Table I shows the distribution of means and standard deviations of the item point scores for experimental and control infants, both male and female, for each of the six Piagetian scales and for the total of six scales.

On Scale I (Object Permanence), the experimental group achieved a mean of 25.5, and the controls 21.0 out of a possible 32 item points. This difference was significant beyond the .005 level for a one-tail t test.

Table II describes those test items from each of the Piagetian Infancy Scales which were passed by significantly more children from either the experimental or the control group. The criterion of significance used was that at least four more infants from one group than from the other achieved a given item. For the Object Permanence Scale there were five items out of the thirteen on which the experimental infants did significantly better than the controls. There were no reverse cases. Indeed, the experimental infants did as well as or better than the controls on each of the nineteen scale items. Fourteen out of 16 experimental infants compared to 7 out of 16 controls followed an object through a series of successive visible displacements with three screens. Ten out of 16 experimental infants compared to 5 out of the 16 controls followed the hidden object through an invisible displacement with one screen; 9 out of 16 experimental infants, compared to 3 out of 16 controls, followed an object through a hidden displacement with two screens used alternately. Perhaps even more interesting is the fact that 5 out of 16 experimental infants, but none of the control infants, achieved following an object through a series of invisible displacements in sequence.

On Scale II (Development of Means-Ends Relationships) the experimental group achieved a mean score of 13.9 and the controls 12.1 out of a possible 24 item points for this scale. This difference is significant at less than .025 level, for a one-tail

t test. Analysis of infant performance for this scale shows that the experimental infants did the same or better than control infants on 11 out of 13 items. They did significantly better on two items. The use of the stick as a means to obtain an object was passed by 7 experimental and 2 control infants; letting go of an object, such as a block, was passed by 12 experimental and 8 control infants.

On Scale III (Development of Schemas in Relation to Objects) there were no significant differences between the groups. However, the control infants did significantly better than experimentals on two items in this scale. From Table II it may be noted that dropping an object systematically was passed by 9 controls and 3 experimentals; drinking from a cup was passed by 13 controls and 7 experimentals.

Scale IV (Development of the Concept of Causality) and Scale V (Development of Space Concepts) showed no significant differences between the performance of experimental and control infants. In Table II we note that on four items of the Space Scale the experimental infants did significantly better than the controls. Dropping objects in order to study their trajectories was passed by all the experimental infants and 11 of the controls; pulling a string attached to a pad in order to retrieve a toy was passed by 13 experimental and 5 control infants; understanding the trajectory of a slowly moving object behind a screen was passed by 15 experimentals and 9 controls. For this scale, control infants did significantly better than experimentals on one item: retrieving an object hidden by an obstacle requiring a complex detour. The item was achieved by 10 controls compared to 5 experimental infants.

On Scale VI (Development of Imitation) the mean item point score for the experimental group was 15.0, and for the control group 13.88 out of a possible 34 points. This difference was not significant. However, on no item in this scale did more controls than experimentals achieve a passing response level. On the item "imitates

unfamiliar visible gestures of hands or feet," 6 experimental infants but no control infants achieved this item.

The mean total Piagetian score combining all six scales for the experimental group was 101.9, and for the control group 94.4 out of a possible 183 item points. This difference was significant beyond the .05 level for a one-tail t test. On only one of the six scales did the control infants achieve more item points than the experimental infants. This occurred on Scale III (The Development of Schemas in Relation to Objects) and the difference was not significant.

In Table 3, when we examine the Piagetian scores separately for sex, the only significant scale difference for males occurs on the Object Permanence Scale. Experimental males earned 25.9 mean item points, and control males earned 20.4 item points. These differences are significant at less than the .025 level on a one-tail t test. It is important to note that experimental males only exceed the item point scores of the control males on scales I, II, and IV. Control males received higher scores than experimental males on the other three scales. Experimental females, on the contrary, earned more item points than control females on 5 out of the 6 Piagetian scales. Their mean total Piagetian score was 106.1 compared to 93.1 for the control females. The difference is significant at the .05 level for a one-tail t test.

Analysis of Cattell Scores

Turning to the Cattell I.Q. scores in Table 4, we find that the experimental infants obtained a mean Cattell of 107.7, and the controls a mean Cattell of 109.3. The difference is not significant. Looking at the Cattell scores separately for sex, we note that experimental males with a mean Cattell of 100.4, and control males[6] with a mean Cattell of 103.1 do not differ significantly. Similarly, experimental females with a mean Cattell of 115.0 do not differ significantly from control females with 114.8.

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[6] Cattell I.Q. scores were available for only 7 of the 8 male infants.

Cross-sex differences, however, are marked. Experimental females are significantly superior ($p < .05$) to experimental males on Cattell I.Q. for a two-tail t test. The advantage of control females over control males does not reach significance.

In addition to the experimental and control infants for whom data has already been reported, we have available Piaget and Cattell scores for 9 additional black infants in the experimental group.

For this larger sample of 40 infants, on whom we have 12 month assessments, a Spearman rank order correlation was carried out between the six Piagetian scale scores and the Cattell I.Q. Table 5 indicates that no significant correlation between any single Piagetian scale and Cattell I.Q. was found, either for the total group or for the experimental and control groups examined separately. For the mean total Piagetian scores, however, the rank order correlation, rho, with Cattell I.Q. was .43 for the 40 infants. This was significant at $p < .01$ level. The rho for experimental infants was .44, and for the control infants .52. Both of these correlations are significant beyond the .05 level.

Discussion

The results of the present study only partially confirmed our hypothesis that a six month half-day program of enrichment in language and Piagetian sensori-motor skills tailored to the cognitive-developmental level of the infant in each area would accelerate the Piagetian development of the enriched infants. On the Object Permanence Scale, indeed, the experimental infants seem to have made advances in dealing with hidden displacements at varying levels of difficulty which the control infants had not yet mastered. It is of interest to compare these results with those of Golden and Birns (1968) who have examined black infants from three groups (welfare, low-income, and middle-class) at 12, 18, and 24 months on the Cattell Scale and on the Corman-Escalona Object Permanence Scale. No differences were found at 12 months

as a function of socio-economic group. One possibility to explain the difference between our findings is that the explicit Piagetian developmental curriculum of the Children's Center may be more efficient than the "hidden curriculum" of the middle-class home in promoting the development of the concept of object permanence. We note further that the median object permanence task passed by Golden and Birns' welfare and low-income groups (which are comparable in socio-economic level to our total sample) was below the level of solution of the invisible displacement problem with one screen. This is quite comparable with the performance of our control infants.

Piaget's theory of sensori-motor development differentiates between "horizontal decalage," in which schemas defining a given stage are extended and coordinated, and "vertical decalage," progression to a next stage. Corman and Escalona (1969) in reporting their work at replication of the Piagetian stage progression for prehension, object permanence, and space, state that while infants "differ widely in the degree to which horizontal decalage takes place, there is no variation in the pattern of vertical progression." Our data on the Object Permanence Scale confirm that there are no infants who succeeded on visible displacement with three screens but failed on visible displacement with one screen. Also, no infants passed the hidden displacement tasks who failed on any of the visible displacement tasks. The data also indicate that the vertical progression to a next stage, ability to succeed on the hidden displacement problems, may be accelerated for a group of infants receiving special enrichment. A majority of our experimental infants, it will be remembered, were able to deal with a one-screen hidden displacement problem, and more than half of the experimental infants succeeded with the two-screen hidden displacement problem.

The sex differences found for Cattell scores within the experimental group and across groups in favor of female infants at 12 months are puzzling to explain.

Bayley (1965) in her analysis of infant intelligence scale scores for 1 to 15 month olds reports no sex differences at 12 months. Gordon and his colleagues (1969) have found that training on Piagetian tasks in a home tutoring program "had a more positive effect as measured by the Griffiths Mental Development Scale on girl infants than it did on boy infants." Since our experimental infants did not differ significantly by sex on their 6 month Cattell scores obtained upon entry into the program, but did differ significantly at 12 months, it might be fairly concluded that females benefited more than males from the enrichment program.

It is difficult to interpret this result. Within the enrichment program neither the tasks and materials nor the care, teaching, and affection provided to an infant favor one sex or the other. Also, it is to be noted that control females achieved higher Cattell scores than control males. One explanation, therefore, may lie in differential home treatment of boys and girls. Bayley and Schaefer (1960) have suggested that low income mothers are more "controlling, irritable, and punitive" but that these differences were "much more evident for the mothers of boys than of girls" . . . and low income "girl babies seem to have been granted a measure of autonomy and freedom from maternal supervision." These data in conjunction with Bayley's (1966) findings that boys' I.Q.'s have a high correlation with maternal affect, may provide clues for the Cattell I.Q. advantage found in 12 month girl babies.

Wachs and Uzgiris (1970) have also examined several different age groups of infants from low income and from middle-class families with the Uzgiris-Hunt Ordinal Scales. Their scale of object permanence did not significantly differentiate the low income 11 month olds from middle-class infants on "number of successes" at each level of progress. However, their infants from low income families "showed less proficiency by requiring more trials to achieve the criterion of success at each level than did the middle-class comparison infants." In contrast, our experimental infants did show

significantly greater numbers of successes at superior levels of performance on the object permanence scale compared to the control infants. It is certainly a tenable proposition that the enrichment program was in a measure responsible for these advances.

The Means-Ends Scale also differentiated our groups in favor of the experimental infants. Wachs and Uzgiris report a significantly lower level of performance by low income infants on their Development of Means subscale at 11 months. Thus, to a certain extent, the kinds of differences which they found between lower and middle socio-economic groups of infants on these two Piagetian scales seem to have been produced in low income infants through attendance in a program with a planned Piagetian curriculum.

In attempting to account for the lack of significant advance of the experimental infants over the controls in Piagetian Infancy Scales II, IV, and V, we examined the data from the wall chart described earlier. A frequency count of teacher activity in the 10 curriculum areas revealed that the tasks by far most frequently carried out with infants were in the areas of object permanence, means-ends relations, language stimulation, and gestural modeling. A more parsimonious explanation of the lack of significant program effects on some of the scales therefore might be simply that the program was insufficient in those areas.

The lack of significant rank order correlations found for any individual Piagetian scale with total I.Q. is not surprising. Each scale taps competencies in a single area rather than yielding a heterogeneous single score as does the Cattell. Golden and Birns found no correlation of the Corman-Escalona Object Permanence Scale with Cattell I.Q. scores at 18 or 24 months. Their rank order correlation just reached the $p = .05$ level of significance at 12 months, with an N of 66. The Syracuse sample rho of .20 for only 40 infants seems to indicate a correlation of Object Permanence Scale score with Cattell I.Q. of the same order of magnitude.

Summary

Further longitudinal study is certainly necessary to see whether the experimental gains obtained will continue or prove ephemeral as the control infants catch up in their abilities to handle tasks of higher developmental maturity.

The advances made by the sixteen low income experimental 12 month old black infants in this study both on the Object Permanence Scale and the Means-Ends Scale compared to their controls offers encouragement to explicitly planned enrichment efforts, based on a Piagetian cognitive-developmental model and designed to offset cognitive deficits that sometimes result when an infant is not provided the variety, sequencing, and challenge appropriate to his level of experiences.

Table 1

Means and t Tests between Groups on Piagetian Infancy Scale Scores

Group	N	Scale													
		I		II		III		IV		V		VI		TOTAL	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Experimental	16	25.50	4.68	13.88	2.42	11.75	2.52	9.56	1.67	26.18	4.87	15.00	5.02	101.88	13.45
Control	16	21.00	3.71	12.13	2.28	12.56	1.79	9.56	1.82	25.25	4.09	13.88	3.98	94.37	10.47
t		3.02***		2.10**		1.05		0.0		.59		.70		1.76 *	

20

* $p < .05$
** $p < .025$
*** $p < .005$

Table 2

15 Items Where at least Four More Children in One Group Passed the Item Compared to the Number of Children Passing in the Other Group

Description of Item		No. Passed (16 children in each group) Center	Control
Center Children Did Better:			
Scale I Object Permanence			
Item 11	Finding an object after successive visible displacements	14	7
Item 14	Following an object through one hidden displacement	10	5
Item 15	Following an object through one hidden displacement with two screens	8	3
Item 16	Following the object through one hidden displacement with two screens used alternately	9	3
Item 18	Following an object through a series of invisble displacements in sequence	5	0
Scale II Developing Means for Achieving Desired Environment Ends			
Item 11	Using a stick to obtain the object	7	2
Scale V Developmental Achievement of the Construction of the Object in Space			
Item 11	Dropping objects in order to study their trajectories	16	11
Item 16	Toy on pad - pull string attached to pad to retrieve toy	13	5
Item 18	Understanding the trajectory of a slowly moving object behind a screen	15	9
Item 24	Use stick to retrieve a toy	7	2
Scale VI Development of Imitation - Gestural			
Item 4	Imitation of unfamiliar gestures	6	0
Control Children Did Better:			
Scale III Development of Schemas in Relation to Objects			
Item 14	Drops the object systematically	3	9
Item 17	Demonstrates drinking from cup	7	13
Scale V Developmental Achievement of the Construction of the Object in Space			
Item 23	Retrieve object hidden by an obstacle (complex detour)	5	10

Table 3

Piagetian Infancy Scale Means and t Tests as a Function of Sex

Group	N	Scale I Mean	I SD	II Mean	II SD	III Mean	III SD	IV Mean	IV SD	V Mean	V SD	VI Mean	VI SD	TOTAL Mean	TOTAL SD
Experimental Males	8	25.88	5.36	13.50	2.62	10.88	3.14	8.88	1.25	24.88	4.52	13.63	4.07	97.63	10.68
Control Males	8	20.38	2.39	11.87	1.81	12.88	1.73	8.75	1.28	26.75	3.69	15.00	2.56	95.63	4.57
t		2.65**		1.44		1.58		.197		.91		.81		.49	

		I Mean	I SD	II Mean	II SD	III Mean	III SD	IV Mean	IV SD	V Mean	V SD	VI Mean	VI SD	TOTAL Mean	TOTAL SD
Fe-Experimental males	8	25.13	4.22	14.25	2.31	12.63	1.41	10.25	1.83	27.50	5.15	16.38	5.76	106.13	15.25
Control Females	8	21.63	4.78	12.38	2.77	12.25	1.91	10.38	1.20	23.75	4.13	12.75	4.95	93.13	14.52
t		1.55		1.47		.45		.13		1.61		1.35		1.75*	

* p= .05
** p< .025

Table 4

Cattell I.Q. Scores and t Tests for Experimental and Control Subjects

Group	N	Mean Cattell I.Q.	SD	t
Experimental	16	107.69	15.01	.32
Control	15	109.33	13.94	
Experimental males	8	100.37	8.77	2.18*
Experimental females	8	115.00	16.84	
Control males	7	103.14	9.23	1.72
Control females	8	114.75	15.62	
Experimental males	8	100.37	8.77	.59
Control males	7	103.14	9.23	
Experimental females	8	115.00	16.84	.04
Control females	8	114.75	15.62	

* $p < .05$, two-tail t test

Table 5

Spearman Rank Order Correlations of Cattell I.Q. with Piagetian Scores

Group	N	Rho between Cattell I.Q. and Scale 1 (Object Permanence)	Rho between Cattell I.Q. and Total Score
Experimental infants	25	.02	.44*
Control infants	15	.34	.52**
Total group (experimental and control infants)	40	.20	.43***

* $p < .05$
** $p < .025$
*** $p < .01$

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